Habitat for Humanity

La Grange, Georgia

2003 Jimmy Carter Work Project

Could 1,000 volunteers using donated materials build 22 homes in just 7 days and could they build them all to ENERGY STAR standards? That's just what the Troup-Chambers Habitat for Humanity of LaGrange, Georgia, did between June 6 and13, 2003, and every home qualified for ENERGY STAR.

These are the first ENERGY STAR homes Troup-Chambers Habitat has built and the experience was so positive, that Walter Hendrix, Executive Director of Troup Chambers Habitat for Humanity said "we are incorporating ENERGY STAR in every house we build from here on out."

"The attention to detail far exceeds the standard practice."

Walter Hendrix, Executive Director of Troup Chambers Habitat for Humanity

Troup Chambers Habitat plans to build 38 homes this year and 30 to 40 per year over the next 20 years as part of Habitat for Humanity International's 21st Century Challenge, an initiative to eliminate substandard housing in the 21st Century. The homes range in size from 850 to 1,252 square feet, and with 2 to 5 bedrooms and 1 to 2 bathrooms. Homes range in cost from $45,000 to $57,000 and are sold through a special no-interest mortgage program to low-income families who invest "sweat equity" in the construction of their own and other Habitat homes. Habitat affiliates across the country built 5,400 houses last year, putting Habitat for Humanity International at number 16 on Builder's list of top 100 U.S. builders.

Hendrix, who took over as president of the Troup Chambers Habitat affiliate in 2002 after 34 years as a private home builder, said he felt building to ENERGY STAR standards produced a better house without a large increase in construction costs over their standard construction.

> *We found no significant increase in materials costs or in subcontract labor costs. It was really more in techniques, heavy caulking, ways to keep unfiltered outside air from coming in. Quite honestly when I had my own construction firm, I had concerns about making the house too airtight. The Building America team members educated us on the right way to seal a house to keep humid air out and to add mechanical ventilation for fresh air exchange. We did a lot more caulking. We used sill seal below the bottom plate, which no one was doing in LaGrange. The Building America consultants showed our volunteers how to wrap the houses, apply the insulation and foam caulk, and wrap duct joints with mastick…The attention to detail far exceeds the standard practice.*

Habitat for Humanity: The 16th Largest Builder in the United States

The US has 1,651 active affiliates who have built 5,400 houses in 2002 and 44,617 houses total since Habitat's founding in 1976. Habitat for Humanity International is ranked number 16 in the Builder Top 100.

Through volunteer labor and donations of money and materials, Habitat builds and rehabilitates simple, decent houses with the help of the homeowner (partner) families. Habitat houses are sold to partner families at no profit, financed with affordable, no-interest loans. The homeowners' monthly mortgage payments are used to build still more Habitat houses. Habitat has built more than 150,000 houses around the world, providing more than 750,000 people in more than 3,000 communities with safe, decent, affordable shelter. HFHI was founded in 1976 by Millard Fuller and his wife Linda.

While Troup-Chambers Habitat hires subcontractors to install the electrical, plumbing, HVAC, and flooring, Hendrix estimates their labor force is 60% volunteer, including some who have never done construction before, so construction techniques have to be simple enough for even novices to follow.

"The Building America team members from Building America's Industrialized Housing Partnership were extremely dedicated, they brought a lot of experience and intelligence to the program," said Hendrix. "They did insulation installation classes with all the house leaders and met on several occasions with HVAC contractors to go through equipment, installation, and duct sealing techniques. They were always there to give us advice on material purchases and decisions."

The importance of air sealing is stressed to the volunteers. A continuous wall air barrier is installed consisting of:

- Sill seal between the slab and exterior wall bottom plate
- Rigid insulation sheathing (over OSB) sealed at all seams and edges
- Tar paper window flashing installed shingle fashion to the sides and bottom of the rough opening then sealed to the rigid insulation and the rough opening with caulk
- Caulk between the window frame and tar paper flashing (applied to each back side of the nailing flange just before each window is set.)

Habitat receives free rigid insulation from Dow and, for this project, used 1/2" 4'x8' sheets attached with collared nails. A continuous ceiling air barrier is formed by the drywall and the top plates of all the walls.

Holes for wiring and plumbing through the rigid insulation, top plates of exterior and interior walls, and the ceiling drywall all represent breeches of the house air barrier and are sealed with either caulk or expanding foam. Common sites for this type of sealing include bathroom and kitchen plumbing and fans, the main electrical panel, outside electrical outlets and water faucets, electrical and plumbing runs through top plates, and dryer vents. Holes too large for foam sealant are first covered or filled in with appropriate materials such as drywall, OSB, or rigid insulation, then the joint

BUILDER PROFILE

Habitat for Humanity

Where:
LaGrange, Georgia

Founded:
1987

Employees:
2 part-time employees
subcontractors and volunteers

Development:
Jimmy Carter
Work Project 2003

Size:
22 homes

Square footage:
850 -1252 sq.ft.
2-5 bedrooms
1-2 bathrooms

Price range:
$45,000 to $57,000

Key Features:

- R-13 batt wall insulation with ½" rigid insulation
- Double-pane, low-e windows; U = 0.39, SHGC = 0.57
- Programmable thermostat
- Heat pump
- Interior air handler closet in two- and four-bedroom homes
- Right-sized mechanical system
- R-30 in attic
- Insulated steel doors

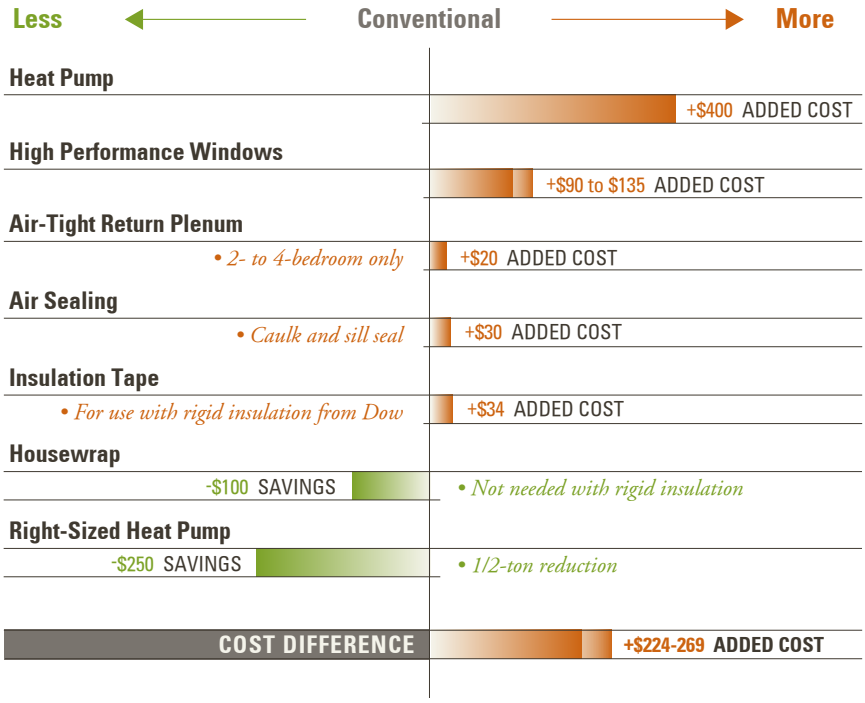
can be sealed.

The rigid insulation serves as both the primary air barrier and the drainage plane in this wall assembly so sealing the seams and edges is critical. Tape designed for exterior air/moisture barrier applications is used because other tapes will fail over time, leaving gaps for both air and moisture intrusion.

The space between the window frame and the rough opening is insulated with strips of sill seal or wall insulation (folded length-wise, kraft face to interior, for easy placement). Where possible, this insulation is caulked to both the window frame and rough opening to back up the air seal on the exterior at the nailing flange. This is complementary to the seal at the window flange, which forms an important element of the drainage plane. Expanding foam is NOT used because it could cause deformation of the window frame and Habitat wanted to teach sealing methods that can be universally applied for volunteers' future work.

Typical wall construction is 2x4, 16" o.c. with R-13 fiberglass batt insulation, OSB, and ½" Dow Styrofoam blue board rigid insulation. All of the houses also have vinyl siding. The typical HVAC system in an average Habitat house is strip heating and air conditioning. In the ENERGY STAR Habitat houses, heat pumps with efficiency ratings of 10 SEER and 6.8 HSPF were installed. Programmable thermostats were also installed to provide more accurate control and performance.

COMPARISON TO CONVENTIONAL MEASURES



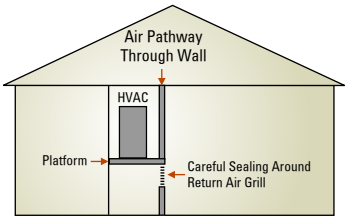
HERS Rating

Each home was tested by a team of Building America Industrialized Housing Partnership researchers, Southface Energy Institute staff, and Habitat for Humanity International staff and volunteers. The average HERS rating exceeded 86.

Source: FSEC

"We will build 38 homes this year and intend to build 30 to 40 per year from here on out. Our goal is to make everyone of our new homes ENERGY STAR."

Walter Hendrix, Executive Director of Troup Chambers Habitat for Humanity



Careful sealing of the air handler closet, including framing in the return air grill, sealed leaks through open wall cavities that could pull hot and humid air from the attic.

Innovations

The two-bedroom homes include a sealed, interior air handler closet. In the air handler closets, the space below the platform was made air tight to provide a continuous path from the return air grill to the opening in the air handling unit. The gap between the ceiling drywall and the supply duct was filled. Caulk was applied at the edges of the bottom edge of the drywall, the bottom plate, and the platform edges.

The LaGrange community was designed as a green-space community with shared greenspace available to residents and residential traffic directed behind the homes for parking.

Comfort, Durability, and Health

The attention paid to air sealing the house reduces infiltration and drafts, saves energy, and improves durability by reducing the movement of humid air through the walls. The air paths that are sealed are also the "bug paths" since cockroach dander is among the top 10 allergy and asthma triggers in the United States, these air sealing efforts are good for occupant health as well. Programmable thermostats allow more accurate control and performance. Double-pane, low-e windows reflect infrared radiation, reduce energy consumption, and prevent carpets and furniture from fading.

The Bottom Line

When asked about costs, Hendrix said "We found no significant increase in materials costs or in subcontract labor costs. It's mainly the attention to detail, it far exceeds the standard practice. Will it cost more? On a typical 3-bedroom house you might realize $1,000 in extra cost. The return on that is probably 2 to 3 years to the home owner."

Atlantic Design & Construction

Gainesville, Florida

Small Changes Add Up to Big Savings

Atlantic Design and Construction of Gainesville, Florida, was already implementing some energy-efficient measures in their new home construction when they heard about ENERGY STAR in 1998. By making a handful of changes they were able to qualify for the ENERGY STAR rating. In fact, these changes were so effective Atlantic won ENERGY STAR's Small Builder of the Year award in 2000.

The firm, founded in 1985, now directly employs 15 full-time employees and sells about 50 to 60 homes per year. Since 2000, they have built more than 300 ENERGY STAR homes.

"Building America helped us by showing us how effective the measures are. Ken Fonorow (of Florida Home Energy Resources Organization, a Building America team member visited us and showed us potential energy savings, he gave us specifics on how to qualify a home in the ENERGY STAR point system. He also did the HERS testing for us," explained Kragiel.

Lucian Kragiel, President of Atlantic Design

According to Atlantic president Lucian Kragiel, the biggest changes from their prior construction methods were switching to low-e windows, upgrading to a higher efficiency HVAC system and water heater, adding fresh air intake, and moving the air handler for the HVAC system from unconditioned space in the garage to conditioned space.

To get to the ENERGY STAR level, Atlantic right-sized the HVAC system, increased the efficiency of the air conditioner and the furnace, added programmable thermostats, switched to R-13 blown-in cellulose instead of R-11 fiberglass batts, and did additional air sealing around the interior where walls meet the slab. They also added filtered air intake in the eaves ducted to the HVAC to draw in fresh outside air. After winning the 2000 ENERGY STAR Small Builder award, they further increased the efficiency of the air conditioner and the furnace (and added a variable speed blower) and changed to double-pane, low-e windows with a solar heat gain coefficient (SHGC) of 0.35.

Innovations

In Atlantic homes, the air handling unit is located in the equipment room which is completely sealed from the garage and attic. A sealed, .90+ AFUE combustion gas furnace is used. The plenum and refrigerant lines are sealed to the sheetrock with an expandable foam at all seams and penetrations. During equipment set, the supply side plenum is affixed and then completely sealed with mastic and pressure-sensitive tape. A metal tap installed in the return air plenum at ceiling height is attached to an insulated flex duct which is connected to a second tap on the furnace side. As an added bonus, the mechanical room is conditioned space, and its area (approximately 15 square feet) is added to the total square footage of the home, increasing the home's value.

HERS Rating and Testing

A licensed, third-party contractor performs final testing and commissioning on each home. **The average HERS rating is between 89 and 90**.

To qualify as an ENERGY STAR® home the building must be at least 30% more energy efficient than a house built to the minimum requirements of the model energy codes, the HVAC system must be properly sealed and a "blower door" test must be performed. During this test the home is pressurized and air leakage is measured. To pass the blower door test a home must have an air change rate of less than 35%. That means that in the course of one hour, no more than 35% of the air in the home will be replaced by outside air through the natural leakage of the structure under average atmospheric conditions. Mentone homes have an average air change rate of 20%.

Comfort, Durability, and Health:

Atlantic installed a simple, non-mechanical fresh air system that introduces filtered, outside air to the return side of the plenum. The air handler (which circulates heated or cooled air in the home) draws approximately 25 cubic feet per minute of fresh, filtered air from a register located under the eaves on the exterior of the home. This creates a positive pressure in the home when the air handler is running and helps restrict the uncontrolled entry of hot, humid, pollen-laden air into the home. Programmable thermostats allow more accurate HVAC control and performance. Double-pane, low-emissivity windows reflect infrared radiation, reduce energy consumption, and prevent carpets and furniture from fading. All ducts are coated with an anti-microbial lining that resists mold and prevents particles of duct board from entering the air stream.

When the air handling unit (AHU) is placed in the garage in a hot and humid climate, many negative consequences can occur. Accelerated rusting in the ferrous heat exchanger and increased evaporator coil sweating are both more likely due to the humid environment and both can shorten the life expectancy of the heating and cooling system. Air leakage can introduce the home to moisture, outdoor irritants, automobile exhaust, and toxic fumes from substances stored in the garage. Ductwork creates an unfiltered pathway for hot, moist air, and/or pollen-laden outside air to enter the home. Atlantic takes care of these problems by enclosing the air handler in conditioned space in the equipment room.

The Importance of Mastic

Little changes can make a big difference. "Sealing the ducts with mastic is I think the single most important thing that anyone should do," according to Atlantic Design's president Lucian Kragiel. Kragiel estimated that average duct leakage in new construction in Florida is 10%, and in older homes it is closer to 30%. "Just sealing ducts on existing homes could reduce the need for new power plants. Sealing gets leakage rates down to about 2%. Not doing duct sealing on new construction is extremely short sighted. Mastic will last the life of the system, while conventional duct tape can fail within a year," said Kragiel.

BUILDER PROFILE

Atlantic Design & Construction

Where:
Gainesville, Florida

Founded:
1985

Employees:
15 full-time employees

Development:
Mentone

Size:
342 Single-family homes

Square footage:
1500 - 2600 sq.ft.
3-5 bedrooms
2-3.5 bathrooms

Price range:
$130,000-$300,000

Key Features:

- Double-pane, low-e windows; SHGC = 0.35
- R-30 unfaced ceiling insulation
- R-13 blown-in cellulose insulation
- Right-sized air conditioners with SEER 13
- Natural gas heating with AFUE = 0.92+
- Natural gas water heating with 0.57 efficiency
- Sealed combustion
- Outside air with pressure balanced return air
- Duct leakage @ 25 Pa <5% of fan flow
- Programmable thermostat
- Air loc recessed lighting

ENERGY STAR® as a Sales Tool

Atlantic started building ENERGY STAR homes in 1998. They offer ENERGY STAR as an upgrade, and so far they have had 100% participation—all of these homes are ENERGY STAR. "We show people the wisdom of ENERGY STAR construction and the economics of it and everyone chooses it," said Kragiel.

Why ENERGY STAR® Makes Good Sense for Home Buyers

Atlantic cites these benefits:

- At least 30% more energy efficient than standard homes
- Lower ownership costs / higher resale value
- Mortgage rate incentives
- High return on investment
- Qualify for a larger home
- Improved indoor air quality

"It's not hard to sell when you educate the buyer, if you can show them (the buyer) that they will get lower utility bills. And they are also going to get a higher resale value on their house," said Kragiel. Atlantic tells buyers that the EPA has partnered with several national mortgage lenders to offer mortgage rate incentives for ENERGY STAR home buyers. Atlantic also makes buyers aware of lenders offering more liberal qualifying requirements for ENERGY STAR mortgages, which allows buyers to qualify for larger homes or additional upgrades. Atlantic made arrangements with its preferred lenders to offer a mortgage rate incentive of a 1/8 % reduction for ENERGY STAR purchases.

Atlantic tells home buyers that every home is individually HERS tested. Upon successful completion of testing, the home will receive a Certificate of Authorization from the Environmental Protection Agency that is fully transferable, which Atlantic says will give their home higher market value at resale.

Even though Atlantic has had 100% participation in ENERGY STAR, they continue to sell it as an upgrade option rather than as a standard feature. "We think it increases its value to the buyer. When it's automatically included there may be some doubt of its value, but when it's optional and you can tell a prospective buyer you've had 100% participation, that shows its value. Plus offering it as an option gives us an opportunity to talk about it," said Kragiel.

The design calls for deep overhangs, which keep sun off windows to keep the home's interior cooler. Double-pane, low-emissivity windows also help keep things cool by reflecting infrared radiation and reducing energy consumption. This photo shows additional building details like flashing between the wall and roof and building paper, which provides protection against moisture. Atlantic also added additional air sealing around the interior where the plate meets the slab.

*Atlantic Design & Construction received the **Energy Star 2000 Small Builder of the Year Award** for its energy-efficient construction.*

"You can make money doing it, and you can feel better about your self at the end of the day, knowing you're making the planet healthier by building better homes."

Lucian Kragiel, President of Atlantic Design and Construction

The Bottom Line

Kragiel said Atlantic's costs to implement ENERGY STAR are about $1700 per home and they sell the upgrade to home buyers for $2200. "You can pick and choose from several options what features you want to add to meet the ENERGY STAR point score. We aim for a high score but just making it at all is an improvement. Our ENERGY STAR upgrade costs $1700 but it (ENERGY STAR criteria) could be met for about half that," said Kragiel.

Kragiel advises builders to educate yourself first and then the buyer. "It (ENERGY STAR) is easier to do than you think. Buyers really do want it when they understand it. ENERGY STAR is becoming increasingly well known. Builders who don't do it, will lag behind," said Kragiel.

"Our experience with ENERGY STAR has been absolutely positive...Sales are going great."

Lucian Kragiel, President of Atlantic Design and Construction

Kragiel notes that it takes a little time up-front to understand how you're going to implement ENERGY STAR and why you're doing it. Atlantic worked with consultants from the Industrialized Housing Partnership of Building America to learn about ENERGY STAR. "Ken Fonorow approached us and showed us the sense in it. We've always been concerned about the environment and making a better product," said Kragiel. "Building America's ideas fit in with our corporate philosophy. It's a good thing to do." And the rewards are concrete: 100% of their buyers purchase the $2,200 upgrade and they've had very few callbacks on the ENERGY STAR features. According to Kragiel, the biggest benefit is the sense of satisfaction of doing something good. "You can make money doing it, and you eel better about yourself at the end of the day, knowing you're making the planet healthier by building better homes."

This outside vent located under the eves provides filtered fresh air to the return side of the plenum, enabling the air handler to drawsapproximately 25 cubic feet of fresh air per minute.

GW Robinson

Gainesville, Florida

Healthy homes for a healthy bottom line - this could be the motto for GW Robinson Builder of Gainesville, Florida. GW Robinson's efforts to build houses that are healthy for the environment and the homeowner are paying off in healthy sales as well.

CobbleField is an in-fill development of 290 single-family homes on 120 acres of woodland just west of Gainesville. The developer won over local opposition with its environmentally friendly design that includes placing homes to maintain as many existing trees as possible and landscaping with indigenous species. The homes, which range in size from 1800 to 4500 square feet, with 3 to 5 bedrooms and 2 to 5 bathrooms, have energy-saving features throughout. Every home is also equipped with water-saving features including an irrigation system using recycled water and circulating loop hot-water pipes. During building, construction debris is recycled whenever possible to reduce trips to the landfill.

Robinson uses non-toxic blown-in cellulose insulation for more even coating over uneven surfaces. Here builders have pre-insulated in an area that will be inaccessible later. The ruler will show how thick the added insulation is. The reflective layer is a radiant barrier in the roof that reflects 95% of infrared radiation and keeps the attic up to 30 degrees cooler.

While doing their part to help save the planet, CobbleField homeowners can breathe easier knowing the indoor air quality in their homes is better than most thanks to low-VOC paints; non-toxic cellulose insulation; coated ductwork to reduce mold, mildew, and fungus; arsenic- and chromium-free wood, and "Air-Loc" recessed can lights that keep moisture and microorganisms out of living areas. The high-efficiency HVAC with engineered duct system, fresh air intake, and programmable thermostats provides improved air quality, better dehumidification, quieter operation, maximum air circulation and air filtration, less drafts, and more even temperature distribution.

Innovations that Set GW Robinson Apart from the Competition

Details like these help give Robinson the edge in the competitive $200,000 to $600,000 price range where CobbleField homes sell. Robinson quotes Ken Fonorow of Florida Home Energy and Resources Organization, and a Building America Industrialized Housing Partnership team member, in its marketing literature saying "Homeowners are now beginning to understand the relationship between indoor air quality and their

"We are taking an approach of wanting to build a better product in all areas—energy efficiency, indoor air quality, no moisture problems, and one that is sensitive to the environment." Building America builders like GW Robinson are coming up with creative solutions like installing irrigation systems that use recycled water . Robinson is thinking efficiency right down to the plants they choose for landscaping, selecting indigenous plants, drought resistant species, grouping plants with similar water requirements, and laying sod in continuous areas only to further minimize water use.

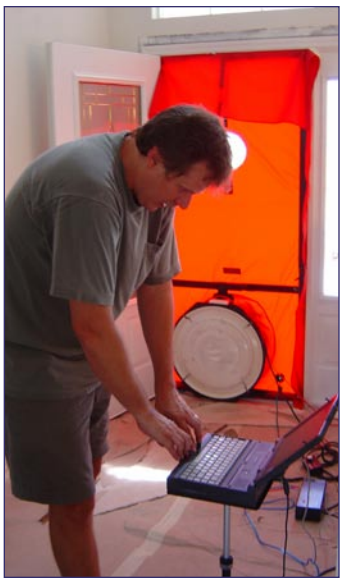
health. At CobbleField, the homes have been designed to reduce the introduction of pollen, to insure that gases, such as carbon monoxide, do not enter the home, and to reduce the growth of molds and mildews."

Building America helps builders identify design features like these that boost a home's energy performance and provide homeowners with the daily benefits they will notice, and mention to their friends. For example, Robinson uses a 50-gallon natural gas hot water heater that has a circulating loop which provides almost instantaneous hot water from every faucet in the house, while saving water and natural gas. (Hot water lines under the slab foundation are insulated for extra energy savings.) Double-pane, low-emissivity windows reduce energy consumption while they reflect infrared radiation, minimizing glare and heat gain inside and preventing carpets and furniture from fading. Inside walls containing plumbing are sound proofed with R-11 cellulose insulation. A radiant barrier in the roof reflects 95% of infrared radiation and keeps the attic up to 30 degrees cooler.

"When we started constructing homes to Building America standards, we realized that we were undertaking a whole new way of home building," says company founder GW Robinson. "At first it was a challenge, but now I can't believe we ever built any other way. You have to pay attention more, to think more about the decisions you're making. Now that we've built 25 homes to this standard, I can honestly say that we'll never go back. This systems approach just makes more sense."

Highly Efficient Homes

CobbleField homes have many energy-saving features: high-efficiency windows, above-code insulation levels, extra attention to duct sealing, etc. But the builder has added some innovations to make significant gains in energy efficiency.



GW Robinson conducts blower door tests of every completed home to check air tightness. Robinson's CobbleField homes have an average HERS rating of between 89 and 90, making them 50% more efficient than standard construction.

BUILDER PROFILE

GW Robinson

Where:
Gainesville, Florida

Founded:
1968

Employees:
22 full-time employees;
225 subcontractors and related service workers

Development:
CobbleField

Size:
290 homes

Square footage:
1,800 - 4,500 sq.ft.
3-5 bedrooms
2-3.5 bathrooms

Price range:
$190,000 to $600,000
average cost at $400,000

Key Features:

- TechShield 7/16" OSB radiant barrier roof sheathing
- Double-pane, low-e windows, SHGC = 0.21
- R-30 green fiber blown-in cellulose in the ceiling
- R-13 green fiber blown-in cellulose in the walls
- Air handling unit in conditioned space
- 13 SEER air conditioner
- Hot water recirculation loop system
- Engineered duct system
- Opposed Blade Damper registers
- Return air pathways
- Right-sized mechanical system
- Recycled water irrigation system
- Ground underslab pretreated against termites.

Special attention was given to the HVAC and duct system with a right-sized, high-efficiency 13 SEER air conditioner and engineered ductwork system specifically designed for efficiency. All floor plans actually have the duct layout on them and no deviation from the layout is allowed by installers. HVAC registers have opposed blade dampers that put the air where it's most wanted and needed. Return air pathways are located in every room in the house. Programmable thermostats allow more accurate control and performance.

Zone dampers are used, enabling one HVAC system to heat and cool the whole house rather than adding separate systems to handle spaces such as bonus rooms. For example, instead of using a 5-ton system for the house and a 1.5-ton unit for the bonus room, a single, 4-ton unit is sufficient. The zones are generally set up with one for the master bedroom suite, one for the formal living area, one for the living area, and one for the bonus room.

In addition to meeting ENERGY STAR criteria, CobbleField also meets the Florida Green Home Standard. To be certified Green Homes, CobbleField was constructed with specific requirements within categories of protecting ecosystems and conserving natural resources, creating a green circulation system, employing green utilities practices, providing resource-driven amenities, operating under existing covenants and deed restrictions, and providing educational information to help achieve and promote green living practices.

"At first it was a challenge, but now I can't believe we ever built any other way. You have to pay attention more, to think more about the decisions you're making. Now that we've built 25 homes to this standard, I can honestly say that we'll never go back. This systems approach just makes more sense."

GW Robinson, President of GW Robinson

Building America—"The Way All Homes Should be Built"

Building America's philosophy struck a chord with Robinson. "CobbleField is our first development to implement Building America building practices. All 290 homes will be Building America. It's not an upgrade option. We are saying, 'This is a Building America development.' This is the way all homes should be built." Robinson added, "Building America will be offered in our future developments. We need to tackle every single issue, not just a few."

The Bottom Line

"Our goal is to be number one in our area in that market. If it (Building America) didn't work I wouldn't use it," said Robinson.

G.W. Robinson targets a return on investment (ROI) of 10%. The lower monthly operating costs of these homes are recognized by lenders in two ways: 1/8 point discounted mortgage rates from certain lenders and buyers qualify for higher priced homes because lower energy bills mean homeowners can afford higher mortgage payments. Overall, higher sales prices give the developer more profit headroom from which to derive ROI.

Robinson offers solar water heaters as an option on its homes.

Keeping the Bugs Out

Anybody who lives in the hot and humid climate knows bugs love it too. GW Robinson builds in features to keep bugs out. Walls and ceilings are insulated with naturally bug-resistant Green Fiber blown-in cellulose insulation – R-13 in the ceiling and R-30 in the walls. The soil underneath the slab foundation is pretreated with a boron mixture to prevent subterranean termites.

Medallion Homes

San Antonio, Texas

They're Getting Better All the Time

Medallion Homes, three time winner of National Association of Home Builders' *Energy Value Housing Award* and winner of their *Builder of the Year Award* in 2000, has been building ENERGY STAR homes since 1999. The San Antonio builder incorporates ENERGY STAR features like high efficiency condensing units, low-E windows, and building airtightness measures in every home it builds as standard features.

In 2001 Medallion partnered with Building America's IBACOS (Integrated Building and Construction Solutions) to see how it could improve energy efficiency and construction quality. The result was a 2400 square foot pilot house built in Universal City, a San Antonio suburb.

Award Winning

Medallion won the National Association of Home Builders and Professional Builder magazine's Best in American Living Award for "Best Affordable Home in the Nation" with its energy efficient Craftsman plan. Medallion is also three time winner of NAHB's Energy Value Housing Award and winner of their Builder of the Year award in 2000.

Key energy-saving features of the Universal City home include the following:

- The house was designed and built with one HVAC unit inside conditioned space rather than two systems in the attic (as is the typical case for this model). This optimization took into account a detailed energy analysis of heating and cooling loads. A variable speed furnace (80% AFUE) and high-efficiency condensing unit (12 SEER) were used. Cooling capacity requirements were reduced from 5 tons to 3.5 tons.
- To improve building airtightness, a great deal of emphasis was placed on draftstopping holes to ensure air barrier continuity. With a strict airtightness goal it was important to minimize the number of penetrations in the exterior shell.
- Air distribution was optimized through a carefully detailed and engineered duct layout that focused on keeping all of the ductwork within the conditioned space of the house. Ductwork serving the second floor was located in a bulkhead constructed in the second floor ceiling space. Ductwork sealing to reduce air leakage focused on the use of UL 181 approved water based mastic.
- A supply side mechanical ventilation system ensures better indoor air quality on a continuous basis. The furnace operates continuously on low speed and draws in outdoor air through a duct connected to the return air plenum. The amount of outdoor air is fixed at 60 cfm by the constant airflow regulator installed.

The home achieved a HERS score of 90.3, exceeding the target of 90.

Lessons Learned

HVAC Optimization

All of Medallion's homes larger than 2,300 sq.ft. typically have two mechanical systems located in the attic. One serves the second floor, the other serves the first floor and ductwork for both is located in the attic, where it is exposed to extreme outdoor conditions. Bringing the mechanical equipment and ductwork inside the home reduced the home's load and energy consumption by almost 25%. This one improvement alone can enable Medallion Homes to downsize from two mechanical systems to one system on houses in the 2,300 to 2,800 square foot floor range.

IBACOS worked closely with Medallion's design staff and mechanical contractor to develop a comprehensive duct system design. Since cooling is the priority, all supply and return diffusers throughout the home are located in the ceiling or high on the walls. For this particular design, the best location for a mechanical closet was on the first floor between the house and garage. From this location, ductwork for the first floor spaces was integrated into the floor structure for the second floor. All of the diffusers for the first floor are located in the ceiling.

A bulkhead was created above bathrooms and closets on the second floor, to create a duct distribution plenum for the second floor spaces. The second floor ceiling was raised to 9'0", while the ceiling at the bulkhead was dropped to 7'8", leaving more than 12" for duct distribution. The majority of the diffusers for the second floor are located at high sidewalls, at the edges of the bulkhead. The diffusers are accurately sized to ensure that the conditioned air is thrown across the length of the room to generate good mixing of all the air in the room.

Implementing a new design in the field proved challenging—many of the flex duct runs were severely pinched by framing members at the secondary plenum in the second floor ceiling bulkhead. The solution involved installing a ductboard supply trunk running horizontally through the bulkhead in the second floor, almost the entire length of the house. All the supply duct runs came off this trunk at locations near each diffuser. Ducts were sealed with UL181 approved water based mastic sealant.

The final duct installation incorporated a horizontal duct board trunk in the bulkhead with flex duct runs perpendicular to this main trunk.

A high efficiency condensing unit and furnace with a variable speed blower complemented the duct layout. The furnace can operate on low speed when no conditioning is called for and distribute the fresh outdoor air provided by the mechanical ventilation system. Due to cost considerations, a zone control system was not installed.

The only thermostat for the home resides in the study on the second floor. To control the high humidity of San Antonio, a Carrier programmable thermostat with dehumidification control was installed; the Thermidistat™ can vary the run-time and airflows of the cooling system to provide maximum latent load removal.

BUILDER PROFILE

Medallion Homes

Where:
San Antonio, Texas

Founded:
1995

Employees:
TBD full-time employees;
TBD contractors

Development:
TBD

Size:
250 homes annually

Square footage:
1,537 - 2,404 sq.ft.
3 bedrooms
2-2.5 bathrooms

Price range:
$110,000 to $200,000

Key Features:

- Radiant barrier on the roof
- Double-pane, low-e windows, SHGC = 0.41, U-Factor = 0.25
- R-30 U.S. Green Fiber blown-in cellulose in flat ceilings, R-19 in sloped ceilings
- R-13 U.S. Green Fiber blown-in cellulose in the walls
- 12 SEER HVAC
- Engineered duct system
- Right-sized mechanical system

Mechanical Ventilation

Since Medallion Homes began working with IBACOS in 1998, they have installed mechanical ventilation systems in all of their homes. Initially, these were dedicated exhaust fans in the laundry/utility rooms. Exhaust ventilation is not the preferred ventilation system in a hot, humid climate and further testing revealed that many of these fans were not actually moving any air. Therefore, IBACOS recommended a new ventilation system for this pilot home, hoping to find a high performance, cost-effective solution for all of Medallion's houses.

When the furnace fan operates, fresh air will be drawn into the house through the fresh air duct, mixed with house air in the return plenum, pulled through the pleated media filter, conditioned by the central system, and then distributed throughout the house. The fan was be set to run continuously at low speed whenever the thermostat is not calling for conditioning. At this low speed setting, the furnace fan moves about 500 cfm of air while using about 100 W of electrical power. This is less power than most energy recovery ventilation systems or heat recovery ventilation systems, so it is an economical option for providing ventilation air. A 5" round duct was routed from a fresh air intake at the second floor band joist and connected to the return plenum near the furnace. This fresh air duct has been equipped with a 60 cfm constant airflow regulator, which will maintain a flow of 60 cfm of fresh air whenever the furnace fan is operating, even at varying speeds.

A fresh air intake duct with a Constant Airflow Regulator runs from the outside to the return plenum. The furnace operates continuously on low speed to provide whole-house ventilation.

Building Airtightness

Air sealing measures include sealing all penetrations in exterior walls and at the insulated ceiling with expanding foam sealant. All windows and doors are also sealed with low expansion foam. In addition, window frames are silicon sealed and wrapped with moisture-resistant barrier tape. The Key™ Sealing System, a polycel foam, is used to seal exterior penetrations (e.g., vents, electrical outlets and door jambs). All bottom plates are caulked to the subfloor, and the drywall functions as the main air barrier in the homes. IBACOS suggested sealing at the furnace/mechanical equipment and at the registers and specified draftstopping for the walls behind, and the lid above, the direct vent fireplace unit and behind the tub and shower surround. Draftstopping is now included in all Medallion homes.

Draftstopping applied at the top of the second floor bulkhead.

The pilot house included a programmable thermostat with dehumidification control. Medallion currently offers these features as an upgrade.

Comfort, Durability, and Health

Front elevation of 2400 plan Pilot Home with synthetic stone cladding

A radiant barrier on the roof structure reflects 95% of infrared radiation and keeps the attic up to 30 degrees cooler. The radiant barrier roof decking works with the continuous soffit and ridge vents, creating air flow to reduce attic temperature. Double-pane, low-e windows reflect infrared radiation, reduce energy consumption, and prevent carpets and furniture from fading. Water-based paint and flooring adhesives don't emit volatile organic compounds, have less chemicals and odors, and lead to better indoor air quality for the occupants. The Cocoon™ blown-in cellulose has a higher fire rating than fiberglass and is a natural, non-toxic pest control.

Medallion homes have fiber-cement siding, which is appropriate for hot and humid climates because it is resistant to rot, fungus, and termite infestation.

The Texas Master Naturalist Alamo Area Chapter presented Medallion Homes the Naturalist Conservation Award in recognition of Mainland Square. Mainland Square was one of the first neighborhoods in Texas to be certified as a Backyard Wildlife Habitat by the Texas Parks and Wildlife Department's Texas Wildscapes Program.

Bottom Line

Medallion estimates that energy features on it's Craftsman model (1,190 sq.ft.), add less than 1.5% to the cost of a home this size.

Medallion tracked of most of the upgrades on the Universal City pilot project and realized significant cost savings realized by optimizing the HVAC—going from two units to one and decreasing required cooling capacity dropped from 5 tons to 3.5 tons. Medallion decided to spend these savings on the upgraded two-speed furnace, the ventilation system, draftstopping for building airtightness and duct sealing measures. As a first-time pilot study, money was spent to fix implementation problems associated with remedying the initial duct layout. In all, Medallion claims that the pilot home project cost them an additional $300. IBACOS believes that there were enough remediation costs associated with the home that if the design was followed correctly from the start, the recommended measures would end up saving construction costs.